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These papers are circulated for the information of participants in the ecumenical enquiry on "The Future of Man and Society in a World of Science-Based Technology". Comments are welcome.

Department on Church and Society, World Council of Churches, 150 route de Ferney, 1211 Geneva 20, Switzerland

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Editorial Note:

"The advent of the modern revolutions in science and technology ... presents certain pressing issues which must be tackled by Christians ... We recommend that the churches use their means of communication to present a clearer picture of what scientific technology really is, and to remind us constantly of the wider political and ethical universe within which it operates."

These propositions of the 1966 World Conference on Church and Society form the starting point for an ecumenical inquiry on Technology and Society launched by the Central Committee of the World Council of Churches at its meeting in August, 1969.

The inquiry, provisionally entitled, "The Future of Man and Society in a World of Science-Based Technology", marks the beginning of a new stage in ecumenical social thought, seeking to relate reflections on the vast technological changes of the present and the future, to the ongoing ecumenical debate about social justice and order. It is one of the principal ecumenical studies planned for the period 1970 - 75, and forms part of the new coordinated ecumenical programme on the human.

Plans for the inquiry are still in the process of formation, and will be completed at an Exploratory Conference of scientists, technologists, social scholars and theologians to be convened in Geneva, June 1970. There is need for an exchange of information and ideas on the critical issues; and to encourage such an exchange we are publishing this bulletin, Anticipation.

Through it we want to make available interesting papers and articles published in different countries and languages. It will be produced three or four times a year and is intended primarily for those directly involved in the World Council inquiry. Articles, reports and essays are welcome. Address all inquiries to the Department on Church and Society, World Council of Churches.

Our chief concern is to encourage theological and ethical reflection on the issues of the inquiry, drawing upon the ideas of scientists and technologists from many disciplines as well as theologians and workers in the field of Christian social thought.

A weakness of the "future" debate, as presently carried on, is that it practically omits the views of peoples outside the industrially developed countries. It will be one of our concerns to look at these issues in a world perspective, giving particular attention to the outlook of peoples in Africa, Asia, Latin America and the Middle East.

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Authors of papers published in this number include: Prof. P.J. Thung of Holland, a medical scientist and a lay theologian; Prof. J. Leite Lopez of Brazil, a physicist; Dr. Masanao Toda of Japan, a physicist turned psychologist.

Geneva, April 1970

Man and Science: The Crisis of Confidence

(This is a shortened, edited version of an article which appeared originally in the Dutch journal Wending (September 1969). The author, Dr. P.J. Thung, is Dean of Studies in the Faculty of Medicine, University of Leiden.)

The theme of man's increased power and responsibility through science and technology is a familiar one. It is a theme which has appeared with more and more urgency lately, in all kinds of variations and keys. Futurologists mostly use a major key, while ethical philosophers strike a minor one; it occurs in many reflections on renewal in education, on the re-orientation of the religious life and on many other subjects ...

Our subject - human power and responsibility - has only assumed its present urgency during the last twenty or thirty years, in spite of the fact that our scientific and technological power is the result of a process which has its roots in the whole history of western civilization.

Until the Second World War human knowledge and ability were generally considered more limited than is the custom today. In biology, for example, certain fields were considered in principle outside the realm of scientific explanation or control ... The following pronouncement, in 1935, from the anatomist Barge from Leiden was typical: "the difference between a lifeless object and a living organism is not a difference of a physio-chemical nature. It is a difference of a totally different and higher order." (1)

As science and technology have become more powerful, it has become clearer how they re-create the world and our life. This is not only because they have an exterior, instrumental influence, but because essentially they act from the inside out, constituting reality. The experiments and manipulation which extend the borders of our knowledge are not just gropings - they call reality into being. The new experiences which are in this way evoked are not, as van Melsen puts it, experiences "which are related facts about reality which were always there, waiting as it were to be discovered by man; these new experiences concern a reality which has only been called into being by the experiment."

From Disgust to Familiarization

It is precisely against this experimenting science, which establishes a reality, that protests are raised and barriers erected. It is argued that life is in this way reduced to something which can be manipulated and measured; while the most essential core of our reality was the mystery, the riddle. Such knowledge makes us superficial and is repulsive and is external. I quote Merleau-Ponty: "If this sort of thinking should gain the upperhand and, pretending ignorance of known realities, should undertake to reconstitute such realities from a few abstract facts, then we will find ourselves in a cultural system which recognizes neither the true nor the false in man and history.

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(1) J.A.J. Barge, Wat is leven, Stenfert Kroese, 1935.

A decadent psycho-analysis and culture in the United States have achieved this, making man into an object of manipulation, which is what he imagines himself to be. Thus we fall into a deep sleep or nightmare from which there is no awakening." (2)

A nightmare? We will have to wake up? The image already suggests two alternative pictures of the world, between which people may doubt which to choose: which is the dream, which the reality? Every new phase in the development of the culture is a nightmare for those who look at it from inside the preceding phase. In the same way Christianity must have seemed a nightmare to the Emperor Julianus, and Luther's Reformation a nightmare to Erasmus. But as the new world gradually becomes more complete and begins to include more aspects of our lives, it becomes more and more difficult to realize that at one time it represented a menace which was alien to our lives.

Since 1967 the extension of our power, and our familiarity with this power have continued to grow. We have become accustomed to the idea of space travel, to transplant biology and to the pill. "Modern man has become the lord both of nature and of his own history" - such a sentence no longer represents anything unusual for us. This sentence comes from an article of Moltmann (3) in the Student World. The sentence however contains more than a statement concerning the extension of our power. It contains by implication a whole programme of action, based on our increasing responsibility:

> "The modern world is open-ended. Modern thinking is geared to the future. Nature is no longer experienced as a static and ready-made reality because modern science and technology have turned nature into the building site of the human world. The structures of society are no longer felt to be given by nature or by God because we know that they are man-made and can be changed by man. Where in the past, we felt personally responsible to these structures, we now feel socially responsible for them."

This programme for action is based on the power to which we have become accustomed which confronts us with our increased responsibility.

Between Power and Impotence

The relation between power and responsibility has of oourse always existed. I quote from Dewey, in 1931 (4): "For what ends shall science be used? The problem involved is the greatest which civilization has ever had to face. It is, without exaggeration, the most serious issue of contemporary life. Here is the instrumentality, the most powerful, for good and evil, the world has ever known. What are we going to do with it?"

Since 1931, the instrumentation has increased tremendously, but we still do not know sufficiently what we are to do with it. We only know the terror and the disgust over what is done in the world by means of, or even in the name of, our contemporary civilization. At the same time we know of

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(2) M. Merleau-Ponty, L'oeil et l'esprit", Les temps modernes, 1961, No. 184/5, p. 144.

(3) Jürgen Moltmann, "God in the Revolution", Student World, Vol. LXI, No. 3 (1968), p. 244.

(4) J. Dewey, Philosophy and Civilization, 1931.

deficiencies in our own society and in the whole world, which could be avoided if we made a more efficient and persistent use of our power.

Then there is the uncertainty about the direction in which these developments will take us: what are the future consequences of the things we do now in a scientific and technological field? All these questions, which can be summed up in the question: how do we keep control over our means of power? - were also valid, in principle, in 1931. To quote Dewey again: "We have displayed enough intelligence in the physical field to create the new and powerful instrument of science and technology. We have not as yet had enough intelligence to use this instrument deliberately and systematically to control its social operations and consequences." Concerning the cause of this failure, Dewey goes on: "Science has hardly been used to modify men's fundamental acts and attitudes in social matters. It has been used to extend enormously the scope and power of interests and values which anteceded its rise. Here is the contradiction in our civilization. The outer arena of life has been transformed by science. The effectively working mind and character of man have hardly been touched."

The enlarged scale of the problem, which has come about since Dewey wrote has not invalidated his diagnosis, but rather made it more threatening. In many respects, humanity is in mortal danger, and these dangers are indeed for a large part to be explained by our failure to control human behaviour, individually and socially, even though a lot has been done since 1931 to redress the balance ... The outcome of all this is still entirely uncertain; here precisely we see the tension between power and impotence. "Modern man has become the lord both of nature and of his own history" says Moltmann, adding "he can be the creator of a more human world but just as easily, his own gravedigger." (5)

What chance has the human race to escape from the present escalation of dangers? Here I refer to the radically different analysis of our situation offered by J.H. van den Berg. In his latest book Metabletica der Materie, the history of the western world is pictured as the history of man in his living spaces, in his exterior world and in his interior world, in being at home and in being lost, in being safe and in being deserted. This history leads to a present in which he is more than ever "at home", but also more than ever lonely and on his own. At home because the world has become finite, within reach and calculable, "his" world indeed. Lonely because there is no longer a place for God in this world, neither inside nor outside. This means, he is on his own, or rather, all men are on their own together; they have to rely on their solidarity, their humanity, which was never before so essential, nor was it ever before so possible. In his earlier work, van den Berg followed a similar road as did G. Marcel and Merleau-Ponty, rejecting his pretensions of science. Van den Berg, however, working with a method which is basically phenomenological, turns aside from this road and ends up at the primacy of matter, and so at the primacy of natural science and technology. That which is exterior, the earth, the dust out of which we are made, these are the most important things. When our world changes, it is not primarily the spirituality, the knowledge of God, in which we move forward, but the empirical, the knowledge of nature (Metabletica der Materie, p. 386). Moving forward in this way, we have arrived in a world which is deserted by God and mortally dangerous, but which is basically habitable. For the first time in his history, man is asked

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(5) Jürgen Moltmann, "God in the Revolution", Student World, Vol. LXI, No. 3 (1968), p. 245.

to manage without God, and to attempt to be together. Van den Berg is of the opinion that we might succeed.

Power as a Mandate

Our sense of responsibility needs much such bolstering. Many of the reactions of today to our problems invite us to flee rather than to take action. The anti-rational and anti-intellectual character of many of the protest movements today in fact tends towards the abdication of man as an authority. Such an abdication is in fact equivalent to the renunciation of our whole history, and so of the essence of our humanity.

From the beginning man has been the creature who creates his own world. From our present knowledge of the history of man, we see him as the youngest shoot on the tree of evolution. The most typical aspect of advance of evolutionary progress in this shoot, is its knowing, manipulating, behaviour which rules over its environment. This is its freedom, but at the same time its destiny, and we must therefore look for further development in the continuation of this line of behaviour. This is as it were a historical task, not only for ourselves, but for the whole biosphere. To quote from Huxley (6):

> "In the light of evolutionary biology man can now see himself as the sole agent of further evolutionary advance. He finds himself in the unexpected position of business manager for the cosmic process of evolution. He needs no longer regard himself as insignificant in relation to the cosmos. He is intensely significant. In his person he has acquired meaning, for he is constantly creating new meanings."

This quotation shows both our responsibility and our possibilities in relation to our present problems. "He is constantly creating new meanings": on the one hand we ourselves must, pragmatically and autonomously, grasp the dangers which threaten us with the power which we have developed. On the other hand, these means contain the promise that we are not for ever tied to the present procedures and objectives, to the present meaning, or lack of meaning of life.

At present, the most serious problem is the danger that we threaten to become a self-destructive form of life, a form of life which will come to nothing. Speaking biologically, only a mutation, a radically new approach, can save us. But it is typical of our history so far that we do not alter our approach through biological mutations. We ourselves created our renovations, by means of the power of science and technology.

Therefore this power is now also our first responsibility: only by making the fullest use of the means which have now been given us, can we hope for a future which will reach beyond our present. Concretely, this means in the first place a scientific calculation of priorities and the programming of objectives which are technically possible. Will this be sufficient to save us? Here much will depend on developments among the human and social sciences, which for the time being are still our weakest spot, as is evident from the continuing validity of the quotation from Dewey. And this shows once again how perilous are our chances at the moment.

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(6) J. Huxley, Evolution in Action, Pelican Books, 1963, p. 139.

But alongside this rational approach of the needs of the moment - a historical mandate which we are not allowed to neglect - we may also affirm our equally historical irrational hope for the future. Certainly we have a task to extend our power - in the first place in order to have power over our power, so that we may confirm the lordship which has fallen to us. This task has to be undertaken technically, economically, sociologically and psychologically. But we may expect that we have not reached our final limit with our present means.

As "business manager for the cosmic process of evolution", man's opportunities for development are open. What direction this development will take cannot be forecast, because we have to do with evolution, that is to say, that which comes after us is on a different level, it does not fall within our terms of reference. A vision such as that of Teilhard de Chardin for instance is grandiose and inspiring, but it cannot be more than a dream for us.

For today, however, we are summoned to undertake with such ability as we may have, in a matter-of-fact way, the problems of our good and evil. That means with laboratory and computer, with planological and social analysis; any other way would be to neglect our historical responsibility.

However, this responsibility to maximize and deepen our present scientific capabilities yet leaves open a perspective into other, albeit hitherto unknown, dimensions.

The Authority as Man

Since my reasoning so far pointed towards a kind of secular belief, I am tempted to a last, short exploration.

In our endangered situation we have the double task of working with our powers, as the only certainty we possess, and of hoping - in spite of our lack of power, and our uncertainty which is so great because of it. But hope can only be maintained if it brings with it its <u>own</u> certainty, and this certainty is faith.

In our cultural history no faith has been more lively and more powerful than the faith in God who revealed himself in Jesus Christ. When this faith has become impossible in a world in which we ourselves are the only responsible authority, what is then the sense in the appeal to <u>any</u> faith or any hope? We have come of age, and can no longer - <u>may</u> no longer - hope for a higher appeal, for a God who cancels our doubt and despair by speaking the last word. As "the authority" we have become irrevocably isolated; and from within the memory of our earlier safety, a belief in progress such as Huxley has is no more than a belief of despair, equal to pulling yourself up by your own bootstraps.

But the proposition that belief has become impossible, and in particular that belief in the God of Jesus Christ has become impossible, bears closer analysis. If this proposition is true then it indicates an impotence which is of a quite different order. Our lack of power, the impotence of which we have spoken so far bears the character of "not yet"; it indicates a reality which we cannot yet reach. The impotence to believe, however, we experience as something "no longer", as a vanished, lost reality. God is dead, we say, thus indicating that a whole dimension of human life has fallen away, has been closed by the way in which we ourselves created dimensions in other directions.

But if we say this, we assume that we are unable to live in several dimensions simultaneously, that we are incapable of superimposing several worlds one on top of the other. The world of our power and our adulthood has grown in and over the world of our dependence and safety, which has in this way got lost from our field of vision. We acquiesce in this as if it were not just our choice, but a fate which cannot be averted. Now, even though it was a true choice, this does not mean that the validity of the alternative has been affected. Even though we have authority, we remain human beings - human beings with the capacity to believe, human beings for whom God became alive: a reality which is co-existant with the reality of the world which we can manipulate, in which we are abandoned by God.

We live simultaneously in many worlds; this ought to be the more clear to a way of thinking which has been under the influence of the natural sciences. The hierarchy of truths, according to which only one world is real, and all the others derived from it, is in origin a philosophical or theological concept, not one connected with the natural sciences. It is precisely science which is aware that truth is functional and partial, conditioned by our starting point and by the methods under which we operate. Precisely because one is acquainted with the sciences, it is possible to accept the simultaneous validity of many possible truths, even if they be philosophically speaking incompatible.

"God is dead"; if we cannot go beyond this, it is because this must refer to a God of philosophers and theologians who wrote the word truth with a capital, and for whom revelation meant indeed a descent from a higher to a lower reality. Of course this God is dead for the man who is the authority, for the man come of age, confronted with the responsibility to subdue the earth and to fulfil the task which has grown out of his history. But God remains a living possibility for the authority who is man, because for him there are other, alternative worlds from those into which he himself was born, where he lives and dies, and for him revelation is the glimpse out of one reality into another.

In the contemporary field of tension between power and impotence we live abandoned; empirical reality rules there, and our irrevocable responsibility. There is no need to be a neo-positivist to come to this conclusion. I refer again to van den Berg: "the earth is our primordium." This primordium does not tolerate a hierarchical transcendant reality: any belief which takes away from our responsibility is precluded. On the other hand, we must also say: "The modern world is open-ended." (7) One of these open possibilities is indicated by Moltmann, who wrote this sentence in the context of an article which is concerned with God in the revolution. This revolution is a faith, and as such it can be a road, a new dimension, along which man may give his lonely empirical responsibility a vision. But it is surely not the only way; for man who has come of age there is an infinite choice of alternative roads. On each of which he may meet Christ.

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(7) Jürgen Moltmann, "God in the Revolution", Student World, Vol. LXI, No. 3 (1968), p. 244.

THE DEVELOPMENT OF SCIENCE AND THE PEOPLE OF THE THIRD WORLD *)

J. Leite Lopes

(Chemical engineer, Bachelor of Physics, Faculty of Philosophy of the Federal University of Rio de Janeiro; Doctor of Physics, Princeton University (U.S.A.); and Doctor of Science, Federal University of Rio de Janeiro. At present he teaches at the Brazilian Centre of Research in Physics at the Federal University of Rio de Janeiro.)

1. Science in Developed and Underdeveloped Countries

The notion of the importance of scientific research for economic development evolved slowly in the countries which today are considered advanced, and this contributed in part to their actual progress.

The reciprocal influences of inventions, techniques discovered experimentally, and theoretical culture especially during the last four centuries resulted in a particular combination of knowledge which characterizes and distinguishes contemporary civilization in history. The search for a scientific explanation of the laws of nature, the attempts at the exploitation and the mastery of the reserves of raw materials and natural wealth emerge as fundamental processes in the historic advancement of mankind and the basis of the generating force of progressive modern civilization. This development of the wealthy nations of the twentieth century, in the final analysis, resulted from man's inquiring attitude toward the universe - an attitude that assumed a socially significant form in the 17th century; it incited the so-called Industrial Revolution, and today exercises a fundamental influence on the economic and political relations among nations.

It is quite true that only recently have statesmen, government officials and men of industry fully realized the role of scientific research as a basic force, through technology, for economic growth. In fact, it was during and immediately after the First World War that the first organizations for the promotion, cooperation and development of scientific research were established ...

The historic processes that assured the advancement of science in the developed countries did not occur - at least, in a continuous and systematic way - among nations which are now designated as underdeveloped. Though many of them were built on ancient civilizations from which we received not only a rich artistic and philosophical heritage, but also the beginnings of science itself, such as geometry and astronomy.

Since the systematic advancement of technology and the search for scientific knowledge were not encouraged in those societies, they lacked the basic instruments for progress in the form that gave rise to modern civilization and, in fact, in order to guarantee its very survival (see Richtie Calder, L'homme et ses techniques, Payot, Paris, 1963). And once the cultural and scientific gap was established between nations, economic and political forces were often responsible for widening it.

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*) This article is taken from the Brazilian periodical Paz e Terra, No. 8, Editôra Paz e Terra, S.A., Rio de Janeiro, September 1968.

In this manner, science and technology became an important factor toward the prosperity of the advanced countries of today. The lack of scientific knowledge and technological means likewise became an influential factor in the retardation of the underdeveloped nations. The absence of conditions which prompted the quest for scientific knowledge - the lack of a system of a universal basic education, as well as technical and scientific education - constituted therefore an obstacle which prevented the underdeveloped peoples of today from achieving the economic and cultural levels that characterize modern progressive nations. And since scientists, scientific institutions and universities are supported and encouraged by the real economic and social progress of a country, the results and benefits of their activities revert mainly, and logically, to the greater development of those countries. The well-known principle that science is universal is essentially applicable, in practice, to the limited universe of wealthy and developed nations.

The underdeveloped peoples remain on the periphery, unable to obtain, adopt and apply the results of scientific research for their own benefit - inasmuch as they are not engaged in it - whereas the reserves and the wealth of the developed countries increase (which actually scrutinize the best means of selling certain kinds of technology) to the point where forces and favorable conditions arise in the former capable of establishing structures adapted to a development that has social significance and political autonomy, that is, without the old or modern characteristics of colonial domination and exploitation.

2. An Example of Scientific Development in the Third World

The evolution of science in Brazil provides an example, among many others, of the efforts employed by a small number of scientists, many of whom have studied abroad, and have the universal qualities necessary for a researcher. Scientific and technological development in the Third World countries, like other more urgent social and economic reforms, generally is in conflict with the interests and privileges of the traditionally dominant elite. As a consequence, it is commonly held that science is not understood by the public authorities and by the private enterprises of those countries.

Nevertheless, the need for doctors to combat diseases and epidemics brought about the organization of the first medical schools in Brazil, in the 19th century.

The first research institutes in Brazil date from the beginning of the present century, when wide-spread disasters, such as epidemics, forced the government to establish institutes of biology and experimental medicine independent of the schools of medicine. Thus, the plague in the city of Santos was responsible for the founding of the Institute Butanta in Sao Paulo, in 1889; the plague and yellow fever resulted in establishing the Institute Osvaldo Cruz in Rio de Janeiro, in 1900 - organized by the great leader of the fight against those epidemics, for whom the institution was later named. Likewise it was as a consequence of the disease in coffee, at the same time, that the Biological Institute of Sao Paulo was founded. However, even in those areas, so closely linked with the health of the population and the economy of the country - and, particularly before the attention of the authorities - scientific development proceeded slowly. Although destined to benefit many people, scientific activities were carried out by a very few.

In Brazil educational opportunities have been the privilege of a small fraction of the population. The schools of higher learning were established later and only formally structured as universities, the traditional professors lacking those qualities of imagination and concern for experimentation and discoveries. This explains the absence of a sociologically significant scientific attitude. The U.S. Senator, Robert F. Kennedy, expressed himself in these words in an address before the United States Senate (see the Congressional Record, May 9-10, 1966, Washington; and also the article "The Alliance for Progress: Symbol and Substance", Robert F. Kennedy, Bulletin of the Atomic Scientists, November, 1966): "Out of 1400 Brazilian children, for example, 1000 start the first grade of primary school and 396 pass to the second grade. Of these, 169 complete the fourth grade of primary school; 20 finish secondary school; 7 enter some type of institution of higher learning - and, perhaps, one out of the thousand in the initial group of children will be graduated by the university. That is, one among 1400 Brazilian children."

Mathematics, physics and chemistry, without the need to overcome disasters, were limited during the past century to courses in professional schools, in the Royal Military Academy (1810) (later transformed into the Polytechnical School of Rio de Janeiro), in the School of Mines of Ouro Prêto (1875), and in the Polytechnical School of Sao Paulo (1896).

Only after the revolution of 1930 did the first schools of chemical engineering appear, as well as faculties of philosophy, science and the humanities, the latter designed to train teachers for secondary schools and, in principle, to stimulate research in science and culture.

According to the census of 1950, the percentage of Brazilians with a technical education was listed at 1.15%; and the number of engineers in the country was approximately 26,000, that is, one engineer (employed as an engineer, administrator, or merely possessing a diploma and a ring) for every 2,000 inhabitants. By comparison, the number of engineers and scientists employed by industry alone in the U.S.A. in 1957 was 738,000 (or about 1 for every 270 inhabitants), of whom 528,000 were engineers, 152,000 scientists, and 58,000 were specialized administrators in those fields.

3. Organizations for Scientific Advancement in the United States

In the United States, universities and foundations intended to encourage scientific research and culture were for the most part established by private organizations, industrial corporations and by wealthy individuals stimulated by a wise provision of the Income Tax laws which made grants to science, education and the arts exempt from taxation. The National Council of Research in Washington, founded in 1916, in association with the National Academy of Science probably until World War II did not have the important role for spreading interest in science which similar agencies had in other countries, or even some private foundations in the United States. It was during World War II that the spectacular applications of science and technology for military uses had such great importance that various organizations were established with - or adapted to - the objective of coordinating the action of the U.S. Federal Government in this field.

In 1950, following five years of discussion, Congress approved the National Science Foundation. In 1951, the President's Science Advisory Committee was formed to assist in the coordination of research. And in 1957, under the impact of the first Soviet sputnik, the President of the United States felt the need to create the position of Special Assistant to the President for Scientific and Technological Affairs in order to coordinate the work of the above mentioned Committee and to advise him on all matters related to that field in each Department and Federal Agency (The report of the National Foundation of Science in the U.S.A. of 1959 begins with this sentence: "A sense of crisis has seized the United States as a consequence of the launching of the first artificial satelite by the URSS, in October 1957").

Stimulated by emergency needs during World War II, the contract and support of scientific research on the part of North American military organizations began to expand and to acquire completely new characteristics, extending to the countries of the Third World and probably contributing to the distortion of the mentality, and even the loyalty, of the scientists of those countries, in most cases deprived of a programme for the mobilization of their own resources for science and education. In his speech before the U.S. Senate, on May 9-10, 1966, Senator Robert F. Kennedy referred to the demoralization that has threatened the universities in the U.S.A. and their professors abroad because of secret research projects ordered by the U.S. Armed Forces in their universities, such as the "Camelot" project. He also referred to the disclosure that Michigan State University served as a cover-up for the activities of the CIA (Central Intelligence Agency) in Vietnam, as well as to the fact that the Centre for International Studies at the Massachusetts Institute of Technology was founded, in part, with grants from the CIA. Here is an excerpt of that speech of Senator Robert F. Kennedy: "To a great extent, we of Congress are responsible for this situation. Camelot was carried out by the Army because far more resources for research are voted for the Army than for the State Department or for AID (Agency for International Development) or for other non-military agencies. The same allocation of resources for research, for non-military agencies, was also the ground for granting funds to MIT by the CIA" (see the Bulletin of the Atomic Scientist, November 1966, page 31).

For men of science, as well as for all people in the Third World, who admire the scientists and the universities of the United States and the basic qualities of the dynamic and inventive Americans, the militaristic aspects that characterize that nation's science and technology and their increasing dependence on the universities and scientists of other countries in relation to those military organizations sponsoring research, cannot help but be a matter of deep concern. Not even Senator Robert Kennedy appears to give adequate significance to the desire of people in the Third World for a programme of development without loss of national identity, for development without loss or abdication of their freedom of decision, for development without impositions, controls, or domination of a neo-colonialist character. Unfortunately, we have these words of Senator Kennedy: "I support the new policy which gives to the State Department, and to the Ambassador in each country, control over U.S. government-sponsored research abroad." It merely remains to be seen if the research which is carried on in the universities and the scientific institutes of countries which receive aid from the U.S. Government for science and technology is considered as research sponsored by that Government.

4. Scientific Progress in the Soviet Union and in the Republic of China

Scientific and technological progress in the Soviet Union was disclosed to the general public in a spectacular manner by their achievements in the space programme, beginning in 1957. Already in 1955, however, during the First International Conference on Peaceful Uses of Atomic Energy which was convened by the United Nations in Geneva, it became clear to scientists and science administrators that extraordinary progress in the exact sciences had taken place in that country during the last forty years.

In the years immediately after the Revolution of 1917, and despite the well-known difficulties with the blockade and the civil war which that country had to face, the number of schools and universities doubled. In 1954, after the devastation and loss of human life resulting from World War II, it was reported that for every million inhabitants 286 engineers were graduated in the USSR, compared with 136 in the United States, 86 in West Germany, 70 in France, and 57 in Great Britain. In 1959, the number of engineers that were graduated in the U.S.A. was approximately 30,000, whereas in the Soviet Union the number was close to 90,000 (see the Tenth Annual Report of the National Science Foundation in Washington, p. 111, 1960). And in 1957, the Academy of Sciences of the USSR comprised about 2,750 scientific institutes with 240,000 researchers.

World attention was drawn to the efforts for scientific and technological development of the Peoples' Republic of China, as a result of an unexpected event, the experiments with nuclear artifacts with the use of uranium 235 probably obtained through costly and very difficult installations for the separation of isotopes from uranium. And just as the scientists of the West acquired information, after 1946, of the scientific projects of Soviet researchers by translating into English the scientific journals of the USSR, they now become acquainted with the work of Chinese scientists through the translation into English of such Chinese journals as the Chinese Official Report.

Actually numerous studies and reports are published in the developed countries in the West concerning the evolution of the educational system of the universities and, especially, the scientific institutes and technological achievements in China. For example see the special Bulletin of the Atomic Scientists of June 1966, entitled "China Today". The National Foundation of Sciences in the United States, on the other hand, published in 1965 a study entitled "Scientific and Engineering Manpower in Communist China", by Chuyuan Cheng, regarding the period 1949 to 1963. The leading organization for scientific planning is the Commission of Science and Technology which includes various departments, such as the supply of industrial necessities, technological research, and international cooperation. The scientific research sector is organized by the Chinese Academy, the equivalent of the Academy of Sciences of the USSR. The Chinese Academy maintains approximately 100 research institutes with about 7,000 researchers. The President of the Chinese Academy is also the President of the National Institute of Science and Technology established for training scientists and engineers, particularly in the fields of atomic and electronic research. According to C.H.G. Oldham, in 1962 there were 40 scientific societies on a national level, with close to 100,000 members; 53 scientific journals with nation-wide circulation were being published and 170 bi-weeklies and monthly magazines containing abstracts translated into Chinese of scientific studies published abroad. Adding the research institutes of the Chinese Academy to the corresponding academies for medicine and for agronomy, the same author estimates that there are about 800 research institutes in China (including those of various ministries), of which 305 are in the field of biological sciences, 205 in the physical sciences,

and 271 in technology. In 1952, only 0.07% of the national budget was allocated for science; in 1960 the percentage rose to 1.54%. The number of engineers that were graduated between 1959 and 1963 increased fourfold.

As far as the countries of the Third World are concerned, the consequences of those events are very great. In the first place, scientists of the developing countries which are in the sphere of influence of the western powers, who bring to the attention of public opinion the efforts toward scientific advancement in the Soviet Union, and more recently that of China, run the risk of finding themselves accused of engaging in subversive activities. Scientists in countries with a military regime run the same risk if they call attention to the need for scientific and technological development in their own countries as an important factor for achieving independence or economic autonomy.

On the other hand, study groups and even institutes are formed, especially in the United States, to discover the best method of selling technology and which types of technology should be marketed, including educational practices and methods, according to their own best interests and not necessarily the interests of the developing countries.

Real assistance in the field of science and technology, in the form of encouragement for scientists to do research in their own countries, so that they can have the benefit of university methods, educational procedures and technological systems adapted to local needs, is extremely difficult to come by. The international organizations are frequently paralyzed in support of such action by the vested interests of the super-powers.

5, The Government and Science in the Underdeveloped Countries

After World War II, a substantial effort toward industrialization was made in Brazil. From 1949 to 1957 the industrial strength of the country leaped from an index of 100 to 279. Petrobras, which was formed in 1952 and faced enormous obstacles, internally and externally, developed to such an extent that ten years later it was able to supply about one-third of the crude petroleum requirements of the country. In 1960 the steel consumption was approximately 2.9 million tons, and expected to reach 5.4 million tons by 1965. During a period of four years, between 1957 and 1961, about 470,000 motor vehicles were manufactured in Brazil.

In 1951 the Brazilian Congress approved a law establishing the National Research Council, under the direct authority of the President of the Republic. However, after 1960, it became evident that the progress achieved and the measures taken were not adequate to provide for the needs of a continuously growing population.

Industrialization, based on the policy of replacing imports, did not maintain its initial growth pattern. This was especially true of the industrial firms in Brazil, the majority of which are subsidiaries of foreign enterprises and corporations, which have their distinctive programmes of profits and investments, that do not always coincide with the best interests of the nation. For that very reason, the influence of such manufacturing firms in the advancement of pure and applied science in Brazil has been practically nil. It is true that those corporations have their own research laboratories in the country of origin - and there they do finance universities and scientific institutes - from which they receive the latest inventions and the newest products. They are not, therefore, interested in encouraging the laboratories and universities of the countries in which they operate - and especially those laboratories and universities that are endowed with autonomy and are capable of developing programmes that would provide for the authentic demands of the people.

As a general rule, the national industries of developing countries make use of the imported - or rented - scientific knowledge and techniques from abroad in the form of patents. Scientific research and technology, the ultimate origin of such corporations, is thus carried on outside the country, and the industrialists within the developing countries do not feel the need to stimulate scientific research and technological invention in their own countries. In fact, many of them in order to survive - and often under pressure from certain local administrations - become junior partners of subsidiaries of foreign corporations.

It is, therefore, the State which should plan and decide upon the educational programmes and maintain the universities and scientific institutes in the developing countries. To allow a free-hand on decision-making in matters of such basic importance to national progress is equivalent to handing national sovereignty over to superior outside forces.

6. Science and Industry in the Third World Countries

While reoognizing that the government of a developing country may be advised by its scientists to adopt a policy to maintain and encourage universities, scientific research and culture, simultaneously with an indispensable programme of intensive basic education, there still remains the fundamental problem of the employment of the scientists of the country by national industry. If these industries operate on the basis of scientific and technological work carried out abroad, it is logical that national scientists will not have much opportunity of employment in the hypothetical research laboratories of their own industrial corporations. This single fact may, perhaps, help one to understand why, in a country like Brazil with a population of nearly 80 million people, only about 500 scholarships were made available in 1963 by the National Research Council for study within the country, in all fields of science and technology; while in the same year only two scholarship students in agronomy, seven in chemistry and one in geology were sent abroad for graduate studies by the same agency. And, if the total number of scholarship students abroad was 86 in 1956, there were 30 less in 1961.

This decline, however, is not an isolated instance in the recent situation in Brazil. Obviously development of science, at a reasonable rate, in the underdeveloped countries cannot take place without removing the fundamental political, social and economic obstacle that impede development generally. If the educational plans are not supported by a national policy of intensive economic development, in the final analysis, they will result in the emigration of scientists and technicians from the less developed to the more advanced countries - in the same manner as the exportation of raw materials (coffee, cotton, cocoa, iron ore) - as a basis of its economy. Programmes and policies for integrating economic life with education, culture and science can only be formulated by national governments which represent the aspirations of the majority of the population: the constant raising of its standard of living along with the assertion of a national culture which is integrated in universal culture without the loss of its distinctive characteristics and richness. If, on the other hand, the plans adopted by governments of such countries are directed to the protection of the interests of privileged groups, if they attempt to yield the national interest to that of foreign groups and governments, those governments cannot reflect the national aspirations of their people and they will be able to stay in power only by diverging from the democratic system -

so highly praised in the advanced countries in the western world - and away from the free choice of leadership by direct ballot. And any programme for the advancement of research through association with powerful foreign organizations, however dynamic, cannot open the way to the flourishing of the science of a people aware of its national and cultural wealth, of its national identification in history and in the community of nations.

Unfortunately, the scientists of almost all countries are not accustomed nor encouraged to discuss these problems. Concerned with the crucial problems of war and peace and the search of new formulas for peaceful co-existence among the great powers, the question of the survival of the less developed nations, of the delicate relations between the aggressive economies of the advanced countries and the national aspirations of the underdeveloped peoples, is either ignored or deliberately put aside. There is, however, an awakening of interest and of understanding of the changes that are now taking place among the developed nations and those of the Third World. An analysis of this type, with reference to Latin America, was recently published by the Brazilian economist, Celso Furtado (see "Underdevelopment and Stagnation in Latin America", Civilizaçao Brasileira, Rio de Janeiro, 1966, page 41): "Once the security of the United States is defined in terms of maintaining the social status quo in Latin America, it becomes perfectly clear that the autonomy of the countries of that area (allowing that the people and the States of Latin America are not to be confused with temporary power structures) to supervise their own development, is reduced to insignificance. It is implicit in that doctrine that the decisions of a fundamental nature will have to be made on the highest level, probably at the political centre of the sphere of influence, or in some world organization whose decision-making power resides in a simple delegation from that political centre. That being the case, it is perfectly natural that it attempts to search out what kind of development the United States commends for Latin America.

"Although there is no unanimity on all aspects of this complex problem, at least with respect to one point there already exists a doctrine firmly established in the United States. This point is that North American private enterprises have a basic role to play in Latin American development and that the policy of United States development aid should be carried out chiefly through these enterprises."

Operating in Latin America and in other areas of the Third World with a series of privileges - which they obtained from national governments - exempt from the regulations of the anti-trust laws in force in the United States, but rather protected by the political and military umbrella of that powerful nation, the North American giant enterprises are, necessarily, transformed into super-powers in most of the countries in the Third World. The analysis referred to above leads us to an immediate conclusion: such a policy of aid and development is detrimental to the genuine growth of scientific research and technology in Latin America and in the Third World, generally. It is perfectly clear that the large foreign private corporations will not set up additional research laboratories in the countries in which they operate - the laboratories in the country where the headquarters are established and their scientists will be the ones to guarantee new ideas and new products and their monopolistic control. Without the possibility of employment in their own countries, the scientists of the Third World will end up by emigrating to the advanced countries.

A great majority of the scientists and admirers of the developed countries, even the most liberal, continue to support the idea that what the under-developed countries must do is purchase (as in a supermarket) the technologies and industries essential for their development. Thus, they overlook the fact that they are supporting the continuation of the dependencies of the Third World countries on the advanced nations, this time no longer as vice-governor or occupation troops, but by means of the more subtle dependence on scientific know-how, advanced technologies, and even on teaching manuals and educational systems prepared in the universities and laboratories of the great powers.

7. Conclusions

1) The acknowledgement of the important role of science and technology for economic development is recent and is the basis of the Scientific Revolution now taking place in the most advanced countries.

2) The independent developing nations cannot fail to adopt as a priority a programme of basic state-subsidized education, of the maintenance and encouragement of the universities and scientific and technological research, integrated with plans for economic growth and national identity.

3) The use of science and technology for a more rapid development of the countries of the Third World, cannot be limited to a passive import of know-how and techniques prepared and patented abroad. Science and technology ought to be stimulated to flourish in those countries, in cooperation with the universities, institutes and scientists of the whole world, preserving, however, political autonomy and decision-making power consonant with the national interests of their people.

4) It is the responsibility of the governments of Third World countries to take necessary measures so that their scientists, engineers and learned men do not emigrate to the universities of the great powers, not by the use of force or the denial of freedom to travel, but by the enticements offered by work in their own countries.

5) The refusal on the part of the large foreign industrial firms to set up research laboratories in the countries of the Third World is a further argument against any aid and development policy of those countries which operate basically through such private companies.

How will these questions be brought to the knowledge of the governments and public opinion in the developing countries? It is clear that the political leaders and men in government in these counties, where there is, generally speaking, a lack of scientific background, are not entirely capable of grasping the chief features of this complex problem. The answer, however, is not too difficult: the basic responsibility for informing public opinion of these countries falls on the shoulders of the scientists in the Third World nations. None of them can claim exemption from this responsibility. The real difficulty is in the fact that the great majority of these scientists - often to avoid difficulties in obtaining research grants - prefer to abstain from such discussions and rationalize their position by claiming obedience to the higher ideal of working for the good of humanity, without distinction of frontiers or nationality. But, for which humanity? Certainly not that which suffers,

although silently, the horrors of escalations and of a chronic war, not the humanity facing ignorance, hunger and misery. The refusal on the part of scientists of the Third World to participate in such a discussion constitutes one more obstacle that blocks the access of the great majority of the human race to the fruits and attainments of modern civilization and authentic freedom.

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III

Statement of a Group of Western Scientists on the Forecasting and Planning of Social and Technological Trends

(The Organization for Economic Cooperation and Development (OECD), located in Paris, is an intergovernmental organization of 22 member countries representing practically all of the industrialized countries of the world with the exception of the Soviet Union and the countries of Eastern Europe. Sometimes called the "Club of the Rich Countries" it is nevertheless concerned with the policies necessary for economic growth in a world perspective.

Within the OECD the Division for Scientific Affairs engages in fundamental research on national scientific research policies needed to sustain economic growth and their coordination. In October 1968, it convened in Bellagio, Italy, a "Working Symposium on Long-Range Forecasting and Planning". The papers of this Symposium have just been published in a book entitled Perspectives of Planning, edited by Erich Jantsch (OECD, Paris, 1969, 527 pages). The following "Declaration on Planning"by the 18 members of the Symposium is reproduced from this volume (pp. 7-9). We hope in a future bulletin to review various essays in this volume of particular interest to students of Christian social thought.)

A Declaration on Planning

We, the participants of the OECD Working Symposium on Long-Range Forecasting and Planning, having discussed the importance which the subject may have at the present stage of social crisis, feel compelled to put forward our views on the potentials of planning as a method of approach to solving many contemporary problems.

Social institutions face growing difficulties as a result of an ever increasing complexity which arises directly and indirectly from the development and assimilation of technology. Many of the most serious conflicts facing mankind result from the interaction of social, economic, technological, political and psychological forces and can no longer be solved by fractional approaches from individual disciplines. The time is past when economic growth can be promoted without consideration of social consequences and when technology can be allowed to develop without consideration of the social prerequisites of change or the social consequences of such change. Diagnosis is often faulty and remedies proposed often merely suppress symptoms rather than attack the basic cause.

The quality of individual life and that of the community is changing rapidly and in many senses deteriorating; foreseeable technological developments will have a still greater influence, presenting both opportunities for a richer life and attendant dangers.

In the corporate environment, the individual enterprise tends to become larger and more complex. Multinational industrial activities are developing which can be expected to influence increasingly political relationships between the nations. This necessitates international planning.

Complexity and the large scale of problems are forcing decisions to be made at levels where individual participation of those affected is increasingly remote, producing a crisis in political and social development which threatens our whole future. It is in relation to this crisis that we feel the planning function and related arts such as forecasting assume new significance.

Having discussed the present state of the art of planning and the diversity of its new approaches we believe that its possibilities including the appreciation of human values transcend mere technocratic objectives. Scientific attack on these problems of complexity and interdependences is a matter of the utmost urgency, and whilst we have what we consider to be a healthy divergence of views regarding the pertinence and scope of individual method and approaches, we are nevertheless convinced that a corpus of knowledge already exists capable of immediate exploitation, and that there is expectation of further and fruitful development.

The need for planning is not generally recognized. Further, the pursuance of orthodox planning is quite insufficient, in that it seldom does more than touch a system through changes of the variables. Planning must be concerned with the structural design of the system itself and involved in the formation of policy. Mere modification of policies already proved to be inadequate will not result in what is right. Science in planning today is too often used to make situations which are inherently bad, more efficiently bad.

The need is to plan systems as a whole, to understand the totality of factors involved and to intervene in the structural design to achieve more integrated operation. All large, complex systems are capable of some degree of self-adaptation. But in the face of immense technological, political, social and economic stresses, they will have to develop new structures. This can easily lead to grave social disturbances if the adaptation is not deliberately planned, but merely allowed to happen.

Recognition of such facts leads us to specify a number of operational conditions which must be satisfied if planning is to evolve its coherent, creative and useful features. In particular:

1. The scope of planning must be expanded to encompass the formulation of alternative policies and the examination, analysis and explicit stipulation of the underlying values and norms.

2. Planning must cope with new situations and devise new institutions. New possibilities of quantitative analysis and simulation of complex dynamic systems using the computer greatly extend our capabilities in this direction.

3. Social and institutional experiments, carefully designed and evaluated, should be promoted to develop a better basis for planning and its implementation.

4. Planning must be understood in relation to the consequences and in particular the consequences to the individual of decisions and actions within social systems. It should therefore be performed at the lowest effective level to make possible a maximum of participation in the planning itself and in its implementation.

5. Planning must nevertheless be undertaken simultaneously at different levels and must be integrated across these levels.

These views and recommendations are expressed in response to trends that are irreversible and world-wide in their consequences. We believe therefore that they are urgent and relevant irrespective of political, social and economic ideologies.

The difficulties if ignored will not disappear. We take it upon ourselves therefore to issue this collective warning that social and technological developments already clearly foreseen can exacerbate matters beyond any hope of peaceful relief. In doing so we express the belief that a basis of remedy already exists to help man to define and create his own future.

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IV

How Distant is the Future?

Masanao Toda

(Dr. Masanao Toda was first Professor of Physics and is now Professor of Psychology at the Hokkaido University, Japan. His paper on "Possible Roles of Psychology in the Very Distant Future" was delivered at the Symposium on Psychology in the Future, held during the XIX International Congress of Psychology, London, 1969.)

Obviously, someone has thought me mad to speculate about the very distant future. He was right. But I am not so entirely foolish as not to try deliberately to misunderstand the task in order to make it easier, employing the rationalization that speculations about a future that you will never live to see would be meaningless unless they provided you with some clues for planning your immediate future. So I apologize in advance to those who expected me to present interesting fantasies in relation to psychology in the very distant future on topics like telepathy, roboto-psychologists, computers that make love, and so on. I will leave such fantasies for your personal dreams, not because I do not like to talk about them - on the contrary. But the true reason for my reticence on these fantastic topics is that they are not fantastic enough. Our future is wild, wilder than our wildest imagination.

To estimate the degree of wildness, imagine, for example, that somebody gave you a time-machine that could go back to the past, and could carry no material evidence to prove you were a time-traveller. Suppose, on board this machine, you moved back two centuries. Naturally, you would be elated by your ancestors' ignorance, and would want to demonstrate the superiority of your knowledge by attempting to teach them physics, say, relativity theory, quantum mechanics, and all those esoteric things. The result? At best, you would start a new religion. Far more likely, you would find your audience blankly smiling at you, and when you blankly smiled back at them they would quietly escort you to a mental hospital.

According to my speculations psychology will make tremendous progress in the coming century, comparable to the progress made by physics in the last century. In contrast to cultural progress, biological progress is slow. So even if I were a time-traveller from the future who knew precisely what the psychology of the very distant future would be, I would not tell you because I am quite sure that your reactions to such revelations will be identical to those of your ancestors.

With these rationalizations I will define my task as that of speculating on the possible <u>roles</u> of psychology, instead of the possible <u>contents</u> of psychology, in the very distant future. This task is easier to accomplish, and I have a conclusion ready.

In the very distant future, psychology will be the master science. It will be the most important of all the sciences. Otherwise, mankind will not survive. At least, so I believe. Naturally this conclusion is not free from premises. The premises are: First, the earth will not be visited by aliens - by extra-terrestrial beings with civilizations superior to ours. Second, Einstein will <u>not</u> be proved wrong; in other words, we will not be able to break the speed-of-light barrier, and mankind will be cooped up in a tiny speck of space called the Solar System, or the Greater Solar System including

a couple of nearby star systems. Putting these two conditions together, it means that the Greater Solar System is virtually closed. We will fill it up sooner or later if we survive, and there will be no exit to the rest of the Galaxy. We will then have to learn, somehow, how to live with our fellow man, and in order to accomplish this very difficult task our attention must inevitably be oriented toward the world within ourselves.

Suppose the Solar System Isn't Closed

My subjective estimate or confidence that these two conditions both hold is not very high. It is particularly so with Einstein's theory. The fact that his theory has remained undisproved for more than fifty years is nothing, compared to the vast span of time we are considering under the ambiguous heading of the very distant future.

In order to keep our subjective sense of time from faltering before such an awe-inspiring span of time, let me propose a devaluation of our conventional time scale. How about calling ten years a blink of time? It goes nicely with calling the Greater Solar System a speck of space. How long is a blink? Let's put it at half a second. With this new scale each man lives an ephemeral life of about three to four seconds. The twentieth century began about three and a half seconds ago, and Christ was born about one and a half minutes ago. Note also that the first man was born on earth about one day back, the first homo sapiens around 25 minutes, the first living thing about six years ago, and the earth was created roughly around eight years ago. And Einstein's theory has passed undisproven for two and a half seconds.

Personally, I feel it is best for the benefit of mankind that Einstein is proved wrong and intergalactic explorations become feasible. Then you will see what will happen. You are psychologists and you know man. No one will be able to stop him from expanding over the Galaxy for exploration and colonization. What will follow this expansion is hard to predict, but most of these earth colonies will esentially repeat our past histories, with infinite variations. They may wage wars and may blow up a couple of planets, but the Galaxy is large and there are always other places for man to survive. Psychology will progress especially through contacts with alien species, because that will tell us what we really are. Needless to say, the greatest hindrance toward the progress of psychology is that we do not know what really we do not know about ourselves. Nonetheless, psychology will not become the centre of all sciences, for there will be too many interesting things in the outer universe to divert our attention from the inner universe. Still, this is a wonderful future of a space-opera paradigm. However, I have here to turn my attention to the comparatively more grim type of future which might be the reality in case the Greater Solar System happens to be closed.

Before going into details, I have to warn you about two points: First, there may be no details. The time assigned to me for this talk is 30 minutes (in the old time scale, naturally) and the time period I am supposed to cover will be something like 30 minutes in the new scale. Of course this comparison is not really fair, since I will not talk much about the future. I will concentrate mostly on the interpretation of the present, to let it serve as the data from which I intend to draw meaningful inferences about the future.

Transitions to the Future

As I have said before, mankind is about one day old, and during most of this short period he has not done anything particularly conspicuous until very recently when he built the pyramid of Gizeh (only four minutes ago). After the construction of the pyramids man did many other conspicuous things, but almost the only form of mechanical energy utilized for his doings was the muscle power of men and animals until the steam engine was invented by James Watt (ten seconds ago). It is during these last few seconds that the human environment has changed so tremendously, as highlighted by the landing on the moon(a few microseconds ago). Obviously, the speed of change has been constantly accelerated. In most of our ancestors' time it was quite natural that one died in a world which was little different from the world he had been born. But some of us in this meeting have experienced unprecedented world wars, which changed almost everything - not just one war, but two.

By pure coincidence, we seem to be witnessing a very special period in history. It is special not because we have landed on the moon or discovered some of the secrets of atoms, but because this is a period of great change, which I would like to call the transition. We are very lucky to witness this, since the transition will occupy a negligibly brief moment in the vast span of time that will be human history - provided man survives the transition.

According to my speculation, the present transition will not be a singular occasion. As long as man survives, he will occasionally experience similar transitions, the present one being the first of a great magnitude. Each time, however, the transition will take place in a comparatively short period, and between transitions we shall have relatively long, near stable periods.

You may ask, of course, why I assume the transition to take only a short interval of time. Cannot ours, for example, continue indefinitely, marking progress after progress? This seems, unfortunately, utterly impossible, because the change is inexorably accelerated. If you are dubious about the fact of acceleration, I suggest you pick a couple of important indicators, like the maximum speed of human locomotion, the average rate of energy expenditure per person, the average rate of information transmission addressed at each person, and so on, and plot their values against chronological time. The curves will clearly show acceleration, and for some of them the rate of acceleration, too, may appear accelerated. By extrapolating these curves, you will find that they go to infinity even before the end of the present century.

Probably you do not believe in extrapolations. Neither do I. That is the whole point. If these measures, and therefore the underlying processes, are not allowed to go to infinity, then something must happen, intentionally or unintentionally, to slow down the speed of change. When this happens, the braking action will inevitably create tremendous heat. It seems to me that there are already signs to indicate the nearness of this stage.

In order to interpret the essence of the transition correctly, we need a well-chosen set of macroscopic measures to represent the process. Since no such set exists, I will do my best here with only one measurer, which I shall call energy for the lack of any better name. It is not the energy of physics that is to be conserved, but it is energy in the everyday sense - something to be consumed. The notion I want to use here is negative entropy, which would

nicely subsume the properties of energy and information if properly generalized from its original physical sense to a new notion with the wider coverage I need now. The generalization, however, is neither easy, nor have I time to venture one. So, as a best substitute, let me use the everyday sense of energy, which actually is close to the notion of negative entropy in physical systems. It does not, however, cover another important form of negative entropy, information. So let me emphasize here, to make up for my shortage of the coverage of the notion of energy, that, very roughly speaking, information and energy are convertible to each other. For example, geological information allows us to tap a large underground source of energy like petroleum and coal.

In this mining process, as well as any other processes in which we are concerned, the primary agent who uses information to get energy is man. It is man's works that make all these "conversions" possible. And work consumes energy. The energy is primarily supplied by the food he takes. In ancient times, work was done for the most part to obtain food, as it still is in many parts of the world, which makes the process a closed cycle. Here, however, the factor of fluctuation comes in. Sometimes people suffered misfortune, and died for a shortage of energy. And sometimes they were lucky and obtained excess energy. Some portion of such excess energy might have been converted to information. Some such information might have been useful in obtaining more food with less energy. It would then increase the probability of obtaining more excess energy. This situation was the beginning of a positive feedback process in the form of an information-control cycle.

So far, human civilization has flourished, and we seem to have enjoyed it. This is testimony to our superb adaptability. Every morning, while munching our breakfast, we read newspapers reporting a couple of technological breakthroughs which will later have great impact on our society, the kind of breakthroughs our ancestor experienced at best only once in his lifetime. Still, we are not at all impressed, nor is our appetite spoiled. Even this surprising adaptability must have its limit as we are often warned. But long before this limit is reached, other things in our society will reach the breaking point first. They are our social systems: political, economic, educational, legal. The original forms of these systems were created long ago to handle much less energy (including information) than they have to handle now. We have constantly revised them so as to meet new demands, but there are structural limits to their energy-handling capacities. Once their capacity is reached, there will be an overflow. The disorganized energy-overflow, no longer channelled by systems in a constructive direction, will properly be called heat. Although I cannot elaborate my argument now, an intense heat will tend to disorganize the internal structure of these systems. In Japan it is the university system that is now about to melt.

The Need for New Information-Energy Conversion Systems

As I mentioned moments ago, man may be viewed as the catalyzer in the information-energy conversion process, and one of the greatest products of this catalyzing act is the growth of social systems, which is again a form in informing accumulation. So while systems were functioning properly, they absorbed people's excess energy and grew. When two systems became obstacles to each other's growth, they collided, as in wars. But soon, if nothing is done to prevent it, the time may come when no systems will be solid enough to collide effectively.

I am oversimplifying, of course. As I said before, we need a much more rigorous social psychological science to make dependable predictions. Still, there are symptoms suggesting that from now on social systems may fail not because of corruption or defeat in conflicts, but because of their inefficiency as systems in an extremely energized society. One of the symptoms is the prevailing feeling of purposelessness among the younger generation in highly energized societies, indicating a lack of ideologies and beliefs, strong enough to absorb their energies.

Naturally, I could say a lot more about these things, but my time is running short. However, I hope that I have made my point clear. We are about to face the very important problem of finding an entirely new kind of social system which can effectively absorb a very large amount of energy so that the social temperature can be lowered. In order to absorb people's energy effectively, the system must provide them with a strong purpose to which they can willingly devote their ever-increasing excess energies. The problem is unprecedented, and the solution must be of a kind never dreamed of before. For example, the solution may take the form of dynamic systems, in contrast to contemporary static systems - dynamic systems that will allow their constituent members extreme mobility, spatial as well as vocational and positional. At least, one thing is clear; we need to find entirely new dimensions for systems to absorb a lot of new energy, and such a new dimension may only be found through knowing man better, knowing what really makes him tick.

Even that, however, is not enough. Suppose we find a solution. In the new social system almost everybody is happy, since each person is given a meaningful role which allows him to spend his energy toward a constructive goal. The result? A tremendous upsurge toward progress. It will be only a matter of time before the new system becomes incapable of handling all the newly created excess energy.

The final solution, therefore, should be a social system that not only absorbs all the loose energy but also puts an end to the positive acceleration. This appears an almost impossible task, but we seem to have no choice. The end of the present great transition is in sight, a couple of seconds at most. If we succeed in finding such a final solution in time, then the static period following the transition will be rather a pleasant one. Otherwise, we cannot maintain civilization, and at best we will have to start all over again from barbarism. Whether or not we will succeed in finding the solution depends on how rapidly we can advance the new psychology.

Although it is certainly beyond my capacity to envisage the characteristics of this final solution, let me venture a couple of speculations with which I can justify this presentation under the title of the roles of psychology in the very distant future.

Must the Freedom to Produce Energy be Curtailed

Obviously, the primary role of psychology in this future society, which is assumed to be in the state of dynamic stability, is to contribute to the soundness of the society. As assumed, the society is highly energized, and since there would be no stable solution that allowed some small fraction of the people to monopolize energy, every individual would be bestowed with abundant energy and information at his disposal. The very dynamicity and stability of this society will imply kaleidoscopically changing yet profoundly self-disciplined

cultures. Such a society may give you an impression of a sort of utopia, and it really is in a certain sense. However, the people living in this era will envy us, the inhabitants of the transition, who had one basic freedom which they miss - the freedom of reproducing energy. In my hypothesis, this freedom of reproducing energy through energy-information conversion, or in plain words, the freedom of voluntary work, is the very core of human motivation. The renouncement of this freedom, which is inevitable to maintain the stability of a highly energized society, will not be a task that is easily achieved and maintained. First, it can be achieved only through unanimous consensus, since no person in this society will have a power to force others to do things against their will. The expected very high mobility of people in this society alone will put the whole society in a sort of fluid state rather than a solid state, and in a fluid-type society no particular person or persons can be almighty.

Such a consensus may be obtained through proper education, provided that there always remains some way for each individual to satisfy his motivation for doing something worthwhile. The heavy burden and grave responsibility of finding a solution to this problem will be put upon the shoulders of psychologists. They should therefore go deep into everyone's nook and cranny of motivation on the one hand, and on the other they should carefully plan and calculate the net effect of everyone's works.

Not that individual effects must always cancel out. This is plainly impossible. Probably, one thing that should be tried would be to give to potential trouble-makers, the creativity-thirsty few, really grand projects, so grand that no immediate energy return can be expected. I am rather unimaginative and can find only trivial examples here, like putting asteroids together to form a new habitable planet, or teaching animals to talk with an artificial vocal chord, or finding a new space-time conception that will make relativity theory a special case, and so on. However grand the projects may be, the time will come sooner or later when some of them will be completed and may produce a tremendous amount of new energy; furthermore, there will always be the danger of dismally useful byproducts. So the psychologists who are engaging in the grandest of all the grand projects, the one of finding an even better solution of a stable society that can be maintained under an even higher energy level, must hurry. Once this is done, people can enjoy another transition, the carnival of mankind, the time of almost unlimited freedom. If you are creative, you may create anything you want, even a crazy machine that produces energy rather than consumes it. If you are a power-thirsty type, you may even be allowed to attempt to build your own absolute monarchy through an abuse of the knowledge of very advanced psychology to control people. This attempt, however, is bound to fail, because long before reaching this stage psychology will have had to overcome the dangers of its own abuse, dangers even more serious than that of nuclear warfare. Still, you will be allowed to try, because there will be psychologists whose science will be so rigorous that the successful ending of the second transition will be 99.999% guaranteed.

So here I come back to my conclusion again. Psychology must be the master science in the very distant future. Otherwise, mankind will not survive. Whether or not you believe me, probably all of you will agree to my other, more practical conclusion: government, of <u>your</u> country, should spend more money and manpower, or equivalently, energy and information, to facilitate rapid advancement of psychological science. The need for a really powerful science of psychology is already great, but will accelerate, in order to effectively prevent nuclear wars, to find new dynamic social systems, and to let the precious mankind survive. And we cannot wait very long, certainly not till the very distant future, to achieve this goal.

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